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Hydropower resettlement and livelihood adaptation: The Nam Mang 3 project in Laos

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ABSTRACT

Mekong hydropower is developing rapidly. Laos is at the forefront of this development. While hydropower development supports the country's economic growth, many observers have highlighted the potential negative impacts for people's livelihoods. Taking the Nam Mang 3 hydropower project as a case study, we examine the impacts of hydropower development on farming households of differing livelihood assets and resources, and how they have responded to these impacts. Linking livelihood asset substitution with livelihood outcomes, we examine factors constraining livelihood adaptation and how these shape rural households' strategies to cope with socio-economic and environmental impacts from hydropower development. We conclude that while asset substitution generally can improve people's livelihoods, access to land continues to play an important role in the process of livelihood reconstruction and the shaping of livelihood outcomes.

1. Introduction

Mekong hydropower is developing at a rapid pace, due to increasing demands for electricity, and the pursuit of national revenue generation from energy exports. As of 2012, there were 43 commissioned dams in the Mekong Basin, and another 116 planned for construction (Bui and Schreinemachers, 2011).

Laos is at the forefront of this development. Nationally, hydropower development is perceived as the country's primary means to promote economic growth and achieve its defined development targets through industrialization and domestic market development and, importantly, as source of government revenue. Regionally, international financial institutions, such as the Asian Development Bank

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(ADB), present Laos' hydropower potential as an integral part of its (the ADB's) regional power trade plan, emphasizing the country's potential role as the battery for Southeast Asia (ADB, 2009).

Laos shares borders with five countries: Thailand, Vietnam, Cambodia, China's Yunnan province, and Myanmar. The country's economy is primarily based on agriculture and the extraction of natural resources, mainly from hydropower and mining. Of Laos's 26,500 MW hydropower potential, 18,000 MW is considered technically exploitable, providing the Lao government with an opportunity to earn foreign exchange to support socio-economic development (ADB, 2009) and graduate from its status as a least developed country by 2020 (UNCTAD (United Nations Conference on Trade and Development), 2012; UNDP (United Nation Development Program), 2012).

The rapid pace of dam construction in Laos has caused environmental and socio-economic changes, impacting local communities (IRN (International Rivers Network), 2004; Baird, 2006; Baker, 2012). Several scholars have discussed the impacts of hydropower development on resettled communities and people living downstream of the dams (Baran, 2005; Baird, 2009; Molle et al., 2009). While important, these studies do not always consider the impacts of hydropower development on farming households of differing livelihood assets and resources, and how they have responded to these impacts. Moreover, these studies do not always position livelihood asset substitution as an integral part of livelihood outcomes analysis.

We endeavor to move the analysis of hydropower development and resettlement further by examining impacts on a range of farming households in three dam affected villages. We examine how local communities in the three villages cope differently with socio-environmental changes resulting from the Nam Mang 3 hydropower development, depending on their livelihood assets composition. We examine rural households' sources of income, expenditure, food security, and how these evolve over time, as our main indicators to analyze the linkage between livelihood asset substitution and livelihood outcomes. We consider livelihood adaptation strategies and changes in land use since dam construction. We also identify benefits gained by local communities and factors constraining livelihood adaptation and development. We conclude that while asset substitution generally can improve people's livelihoods, agricultural land continues to play a crucial role in the process of livelihood reconstruction and the shaping of livelihood outcomes.

2. Can livelihood asset substitution sustain and improve livelihood outcomes?

The current discourse on resettlement has been shaped largely by two polarized views, that resettlement could benefit local people in terms of providing access to markets and state services, and thus partially reduce poverty; and that resettlement actually exacerbates poverty (High, 2008). Rigg (2006) highlighted the basic foundation in what he calls as 'orthodox development wisdom' that poverty arises due to isolation from markets, services and opportunities. This differs from the view of some critics of resettlement, who often have identified poverty as a 'new' side effect of development. Cernea (1995) and Downing (2002), for example, discussed how development induces displacement or resettlement, often posing major socio-economic consequences and impoverishment risks for resettled people, including joblessness, homelessness, food insecurity, shortages of common land and resources, increased health risks, disruption of education activities and loss of human rights.

We show that having access to markets and services is not always linked to greater economic opportunities, or increases in rural households' ability to rise above the poverty threshold. A few studies have shown that resettled communities can regain or improve their living conditions (Nakayama et al., 1999; Agnes et al., 2009). But more studies have also shown how resettlement can reduce living standards and rural impoverishment, and have significant health impacts (Lerer and Scudder, 1999; Bartolome et al., 2000). We suggest that rural households' ability to rise above the poverty threshold would depend on the composition of their livelihood assets before and after resettlement, how they shape their coping strategies based on these assets, and how these strategies lead to different livelihood outcomes (Bui and Schreinemachers, 2011; Bui et al., 2013).

Several scholars (Ellis, 2000; Krantz, 2001; Hussein, 2002; DFID (Department for International Development), 1999) have also shown how existing livelihood assets can be substituted with other types of assets, thus partially supporting the current thinking that changes in livelihood assets do not necessarily undermine livelihood outcomes, if rural households can rely on other types of assets to deploy their

adaptation strategies. Nevertheless, central in the analysis of livelihood asset substitution is the question of whether or not rural households have a wide range of livelihood options, especially due to their lack of expertise and technical skills with regard to alternate careers, outside their farming households.

In line with Ellis's (2000) definition of livelihood diversification strategies, we define livelihood asset substitution as: the substitution of existing livelihood activities and access to resources by other types of assets pertaining to rural households' ability to ensure food security and increase income. Referring to the sustainable livelihoods framework (Carney, 1998; Scoones, 1998) we distinguish five types of livelihood assets: (1) human capital (e.g. education, skills and health of household member); (2) physical capital (e.g. farm land, farm equipment; access to road and markets); (3) social capital (e.g. social networks); (4) financial capital (e.g. micro finance, savings, cash compensation); and (5) natural capital (e.g. access to natural resources, forest land and fisheries).

Within the context of hydropower development, livelihood asset substitution is often incorporated in the project's Resettlement Action Plan. We describe livelihood asset substitution from the Nam Mang 3 hydropower project, looking mainly at how the project has benefited the local communities in terms of improving access to roads, markets, and higher education facilities. Moreover, we describe how the project has substituted the affected communities' livelihood assets, with particular focus on farmland and access to natural resources (e.g. forest land and fishery resources).

We also discuss how local communities shape their adaptation strategies beyond what is included in the Resettlement Action Plan, and how farming households in resettled and impacted communities shape and reshape their adaptation strategies in line with the changes in their livelihood assets during and after resettlement. In particular, we examine how rural households' sources of income, expenditures, and food security have evolved over time, shedding light on the potential role and actual significance of livelihood asset substitution in improving livelihood outcomes since the dam construction. We suggest that the ability of rural households to shift from on-farm to non-farm activities as their main source of income does not necessarily mean that these households are better off now than before the resettlement. Rather, if the households must spend most of their income to purchase food, their ability to substitute livelihood assets in a productive manner will be constrained, and their food security will not be assured. Access to agricultural land continues to play a crucial role in determining household strategies to sustain livelihoods, improve income, and rise above the current poverty threshold. While this does not necessarily reflect the absence of effective policies and programs, it does shed light on potential areas for policy improvement.

3. Research methods

To understand how the Nam Mang 3 hydropower dam development has impacted residents in the two resettled communities (Phoukhaokeo and Phoukhaokhouay villages) and one downstream community (Vunghua village), we interviewed rural household members to learn about their livelihood assets, how these have changed during and after resettlement or dam development, and how these changes determine their livelihood adaptation strategies over time. In particular, we focus our interviews on rural household's livelihood assets in terms of human capital (e.g. access to education facilities), physical capital (access to farm land, road, and market), financial capital (e.g. cash compensation), and natural capital (access to forest land and fisheries), and how these changed after dam construction. Our household survey includes 106 of the 212 households in the three villages. In particular, it includes 81%, 75%, and 36% of the households, respectively, in Phoukhaokeo, Phoukhaokhouay, and Vunghua villages (Table 1).

Table 1
Number of households interviewed in each of three villages in rural Laos, 2013.

Village	Number of households in each village	Number of households interviewed	Proportion of households interviewed (%)
Vunghua	138	49	36
Phoukhaokhouay	53	40	75
Phoukhaokeo	21	17	81
Total	212	106	50

To gain insight and information regarding the resettlement processes and socio-economic development at village level, we interviewed the head of the village, village elders and the head of Women's Union in each of the three villages. We also interviewed officials from the District Land Management Office (DLMO) and the District Agriculture and Forest Office (DAFO) to learn about agricultural activities in Thoulakhoum District and, more specifically, the impacts of these offices and their policies on agricultural production in the affected communities. We interviewed officials from the District Governor's office and the Nam Mang3 environmental unit to unravel the relationship between the District Authority and the Nam Mang 3 project office. We also interviewed the Phoukhaokhouay National Park authorities to learn of park policies with respect to local residents.

We also examine the following secondary data: the Nam Mang 3 Social Action Plan (SAP), the NamMang3 Environmental Impact Analysis and Outline Social Action Plan and Environmental Management Plan, conducted by Resource Management Research (RMR (Resource Management and Research), 2002, 2005), as well as presentations on the social and environmental management implementation plan of the dam by Nam Mang 3 staff members.

4. The Nam Mang 3 hydropower dam and the three affected villages

Nam Mang 3 dam is located in Thoulakhoum District, Vientiane Province, about 70 km north of Vientiane Capital (Fig. 1). A so called multi-purpose dam (for both irrigation and power generation), the design for Nam Mang 3 dam is based on a 1993 feasibility study, conducted by Lahmeyer–Worley and funded by the Asian Development Bank (ADB). Sogreah Engineers later modified the dam design, before China International Water and Electric Corporation (CWE) further modified it in 2002 (RMR (Resource Management and Research), 2002, 2005).

Operated by Eletricité du Laos (EDL), Nam Mang 3 dam is a state-owned project with an installed capacity of 40 MW. The Government of Laos (GoL) and CWE jointly financed its construction through a USD 63 million loan provided from the Export and Import Bank of China (China EXIM Bank). CWE and EDL holds respectively 80% and 20% of the total shares (RMR (Resource Management and Research), 2002, 2005).

The construction of the Nam Mang 3 dam started in November 2001 without an Environmental Impact Assessment and without public consultations or participatory planning of mitigation. Following pressure from the World Bank and ADB, however, the company later commissioned a study to identify the critical information needed for the project completion in December 2001 (RMR (Resource Management and Research), 2002, 2005). In 2002, CWE provided financial support to EDL to hire advisory services from Resource Management Research (RMR) to develop the Environment Emergency Mitigation Plan (EEMP) and the Environmental Impact Assessment–Environmental Mitigation Plan–Social Action Plan(EIA-EMP-SAP).Upon completion of these series of plans the Nam Mang 3 dam construction officially re-started in January 2002 and was completed in January 2005.

The inundation of about 1000 ha for the reservoir construction required the involuntary resettlement of 151 households. The Nam Mang 3 project Resettlement Action Plan prescribed that the villagers' losses of livelihood assets pertaining to physical, social, and natural capital would be substituted by either cash compensation and/or new (farm) land allocation, as well as through food, health and public infrastructure (e.g. roads, schools, access to electricity) provision. For this, EDL and the Thoulakhoum district government formed a resettlement committee to carry out the valuation of all non-moveable assets, which included physical capital such as paddy fields, fish ponds, fruit trees, villagers' houses, farm houses, irrigation systems; social capital (e.g. graves), and natural capital (natural fish ponds) in the reservoir area. Grazing and shifting cultivation lands were excluded from the compensation package. Values for lost housing were set against a scale that depended on the house's quality and type. The valuation was agreed with affected households. EDL paid full compensation for all the mentioned assets. Productive paddy was valued at 30,000,000 LAK/ha or 3000 USD/ha (2003)[1], equivalent to the prevailing (low) agricultural land price at the time.

With regard to new (farm) land allocation, the resettled communities were offered 470 ha of non-irrigated land to use as both village and agricultural land. The plan was to provide each resettled household

[1] USD 1 = 10,000 Lak.

Fig. 1. The Nam Mang 3 dam and the affected villages considered in this study.

member with 1600 m^2. The more members in a household, the more land they received. In practice, however, the project could not provide sufficient land to all resettled villagers. There were disputes between original land claimants and project land allocation officers, because the offered 470 hectares included the paddy and preserved land of the original resettled villagers. As a result, some of the households in Phoukhaokhouay village did not receive the land they thought they were entitled to receive. In Phoukhaokeo, villagers misunderstood that if they refused the offered non-irrigated land, the government would provide them with irrigated land elsewhere. The villagers therefore declined to take the offered land.

As part of the Resettlement Action Plan, the Nam Mang 3 hydropower company provided food and health care support to households in three villages for 18 months. Further, EDL constructed a variety of facilities and infrastructure for the impacted communities, which included: a rural electricity grid, water supply for impacted households, and an improved access road. EDL also provided assistance in the construction of a new primary school, renovated an existing secondary school in Vunghua village, and provided financial support for the construction of new primary schools in New Phoukhaokhouy and New Phoukhaokeo villages.

The reservoir flooded the entire village land of Phoukhaokeo and Phoukhaokhouay, which required these villages to be resettled. In particular, the reservoir flooded the paddy fields of 27 households in Phoukhaokeo and 71 households in Phoukhaokhouay. Some households lost their resident land and paddy fields, while others lost only their resident land. Though all villagers were to be resettled, the project compensated only those whose resident land and paddy fields were flooded. Part of the land that was not flooded was later claimed as state's property. In addition, the reservoir also flooded the paddy fields of 91 households from Vunghua village. Unlike the other two villages, however, Vunghua village was not relocated because the land on which the village stands was not inundated.

During 2003–2004, 80 households (27 from Phoukhaokeo and 53 from Phoukhaokhouy) were resettled to a new area located approximately 20 km from their old villages (Fig. 1). Fifty-five households from old Phoukhaokhouy were moved to Vunghua village, and 12 households were moved to other, unidentified places.

5. Benefits and impacts of hydropower development

5.1. Access to roads, markets, water supply and electricity

Since construction of the Nam Mang 3 hydropower project, Vunghua villagers have had access to an unpaved road, which improves access to markets during the dry season, but not during the wet season. This access to roads and markets helps the villagers earn more income from forest products. Our findings indicate that 55% of Vunghua respondents have earned more income from selling forest products since the construction of the road. In Phoukhaokhouay, on the other hand, 40% of respondents report having less access to forest products than before the dam construction, because they now live farther away from the forest. However, 50% of respondents' wives report adapting to this change by collecting and selling traditional medicines from the Phoukhaokhouay National Park. Villagers generate a good income from the sale of traditional medicine, ranging from LAK 5–6 million per year.[2] Only 26% of respondents in Phoukhaokeo collect forest products for sale; while 52% collect forest products for household use; and 18% collect very little, or have no access to the forest.

Since resettlement, villagers are connected to a main water tank, and draw water from taps. However, all respondents complained that they regularly experience water shortages, especially during the dry season, when groundwater levels decline. Eighty-one percent of respondents from the three villages also have access to electricity.

In general, residents of all three villages have been able to increase their household income. Nearly all (98%) of the interviewed households in the three villages have at least one motor bike, which serves as their main source of transportation. Wealthier villagers can afford trucks, cars, or vans. Almost all (90%) respondents in the three villages have been able to purchase a TV, telephone and mobile phone since the Nam Mang 3 project was constructed.

5.2. Education and health services

Residents of the three villages have access to basic education facilities. Children who were born after the project intervention tend to obtain higher education than before. Respondents also perceive that the quality of their children's education is higher than before, given the numbers of people pursuing

[2] One US Dollar = 7865 Lao Kip in 2013.

university degrees. Nevertheless, not many children go to university. Eighty percent of respondents said this is because they cannot afford the cost. Unlike in the other two villages, there was no readily available secondary education for pupils from Vunghua. In general, if they do not receive strong encouragement and support from their families, children often end their education after secondary school.

Neither resettlement village received a health care clinic, because there are several options nearby. There is a clinic at Napheng Village (about 5–6 km away); and the Thoulakhoum District Hospital, or the 704 Army Hospital (both about 5 km away). Family planning in Vunghua and Phoukhaokhouay villages is limited. Ninety percent of respondents have never received family planning advice or training.

5.3. Fisheries and agricultural land use changes

While the Nam Mang 3 hydropower project has substituted villagers' loss of livelihood assets with the construction of new roads, and other public facilities such as water supply infrastructure, access to electricity, and schools, the project was not successful in ensuring access to fishery resources or to new (farm) land, which are important assets for livelihood adaptation.

Most respondents from the resettled villages (Phoukhaokeo and Phoukhaokhouy) have had no access to the reservoir's fishery resources. After the dam construction, they fish primarily for home consumption, along small rivers near their new villages. Vunghua villagers have good access to the reservoir's fishery resources. Most respondents (95%) perceive that one of the most positive changes since dam construction has been their improved access to this resource. All respondents stated that they rarely bought fish products from the market, because they can obtain sufficient fish catch from the reservoir and small rivers around their village. However, 50% of respondents said they were having trouble maintaining the amount of fish they caught, due to competition with fishers from other villages.

Households in the three affected villages received cash compensation for their lost paddy land. In Vunghua, many of the 55 households from old Phoukhaokhoy, who lost their paddy fields purchased new paddy land, while 45% of respondents of original Vunghua redeveloped new paddy land and 15% purchased new paddy land in lowland areas. In addition, some of those households moving from old Phoukhaokhouy continued to farm on the government compensated land, since it was not inundated, and the government had just left it fallow. Others, having lost their paddy land, turned to shifting cultivation in the village forestland or inside the national park.

Despite the significant loss of paddy land, the average paddy land holding per household in 2013 had gradually increased, compared to the average household landholding in 2008 (Chareun and Associates, 2008). Table 2 shows the change in agricultural land use area for Vunghua from 2002 (before resettlement) to 2008 and from 2008 to 2013, respectively. There had been a significant decrease of paddy land per household from 2002 and 2008 from 1.31 ha/hh to 0.74 ha per household. Most households that had lost their paddy land did not prepare new paddy land within those early years after dam development. However, there has been a gradual increase from 0.74 ha/hh in 2008 to 0.97 ha/hh in 2013. Our survey suggests that 45% of respondents have prepared new paddy land from the land they had claimed. The standard deviation is higher than the mean value in 2013 because only 10% of interviewed households had four hectares of land or more, and 4% owned three hectares of paddy, while other respondents owned from 0.5 to 2 ha.

Phoukhaokhouay respondents owned an average of 0.96 ha of paddy land per household in 2002 (before resettlement) (Table 2). In Phoukhaokeo village, the average paddy holding per household

Table 2
Changes in agricultural land use.

Village	Average paddy holdings per household (ha)					Average garden holdings per household (ha)				
	2002 (Avg)	SD	2008 (Avg)	2013 (Avg)	SD	2002 (Avg)	SD	2008 (Avg)	2013 (Avg)	SD
Vunghua	1.31	0.14	0.74	0.97	1.29	0	0	0.01	0.56	1.33
Phoukhao khouay	0.96	0.92	0.3	0.65	1.39	0	0	0.5	0.85	0.94
Phoukhao keo	0.54	0.69	0.03	0.18	0.49	0	0	0	0	0

Source: Author's field survey 2013; Chareun and Associates (2008).

decreased sharply from 0.54 ha to 0.03 ha between 2002 and 2008, before increasing to 0.18 ha/household in 2013 (Table 2). Twelve percent of respondents invested some of their compensation money in new paddy land, while the remaining 88% invested their money on constructing new houses and buying household equipment. Those who did not purchase paddy land said this was because they had owned small plots before resettlement. This was generally true of many respondents from Phoukhaokeo Village, which had less land on average per household than villagers in Phoukhaokhouay and Vunghua in 2013. They had less land prior to dam construction, and they have less land now.

Most households in Phoukhaokheo Village declined the garden land offered by district authorities because it was not irrigated. Only two households accepted the offered land, while other respondents explained that they had expected to be offered irrigated land instead of garden land. By declining, the households had expected district authorities to look further for possible irrigated land. According to two members of the former District Steering Committee, however, garden land was never a part of the compensation package, but rather a 'gift' from the district government, and was therefore not related to the resettlement action plan. Moreover, since many resettled households had accepted cash *in lieu* of land, they were disqualified from receiving any additional compensation.

Due to the shortage of agricultural land, many of the resettled households in Phoukhaokeho and Phoukhaokhouay villages have resorted to renting paddy land, shifting cultivation, and gardening. The lack of land remains a considerable concern for many in the resettled communities. This is evident in the villagers' livelihood strategies, as many seek to reduce the number of livestock they own, or shift to poultry production.

In theory, the resettled community from Phoukhaokhouay village could continue to use their old communal grazing land as this area was not inundated. In practice, however, they were unable to visit their herds regularly, due to large distance between their old land and the new village. For this reason, many rural households had decided to sell many of their livestock, while some stopped raising livestock. The average number of livestock per household decreased from 9.4 in 2004 to 6.5 in 2013 (Table 3). Phoukhaokeo villagers also could no longer look after their livestock properly since migrating to the resettlement areas. Currently, none of the interviewed households in Phoukhaokeo is raising livestock, but raising only poultry. Unlike the other two villages, all Vunghua respondents have access to sufficient grazing land, but there is improper management of communal pasture. There is inadequate grass plantation in the dry season and the herd suffers from disease. The average number of livestock per household in Vunghua has declined from 23 in 2004 to 16 in 2013 (Table 3).

6. Livelihood outcomes after long-term adaptation

The impacts of the Nam Mang 3 Resettlement Action Plan on households and communities vary across the villages in our study area. Our review of the impacts on income, expenditures, and food security reveals the importance of maintaining access to farmland and grazing areas, as these are critical resources for ensuring that households can sustain viable livelihood activities.

Table 3
Average number of livestock.

Villages	Average head per household in 2013	Standard deviation	Average head per household in 2004	Standard deviation
Vunghua	16	SD = 24.17 Max = 150 Min = 0	23	SD = 23.93 Max = 120 Min = 0
Phoukhaokhouy	6.5	SD = 7.72 Max = 40 Min = 0	9.4	SD = 10.99 Max = 42 Min = 0
Phoukhaokeo	0	NA	1	SD= Max = 1.60 Min = 0

Source: Author's field survey 2013.

6.1. Income sources

Annual incomes from seven common income sources and other miscellaneous sources were calculated for each village (Fig. 2). Sales of large livestock generated considerable income for Vunghua respondents. Phoukhokhouy respondents, however, generated a higher income from selling traditional medicine while Phoukhaokeo village respondents generated more income from non-farming sources.

The average annual income per household in Vunghua village is higher than in the other two villages (Table 4), because Vunghua residents have access to grazing land. Consequently, the amount of income they receive from selling livestock is highest among the six income sources.

Most households in the three villages have annual income between 1 million and 10 million LAK (Table 5). The standard deviation is very high in the three villages, suggesting there is substantial variation in the incomes earned by the households.

Most respondents in the three villages said their main livelihood activities are paddy rice and shifting cultivation, but no respondents reported selling rice or any agricultural products, as they are able to produce just enough agricultural products for home consumption. There have been some surpluses in some years, reported from some Vunghua respondents but the surplus production was not sold, due to lack of access to a market and inadequate road access. Moreover, given that a small amount of surplus would not generate significant profit, most households preferred to keep the small amount of surplus production and sell it only to other households who needed to buy a small amount of rice.

Unlike residents in the other two villages, women in Phoukhaokhouay village sell traditional medicine and some village men works for construction works. Men and women in Phoukhaokeo earn most

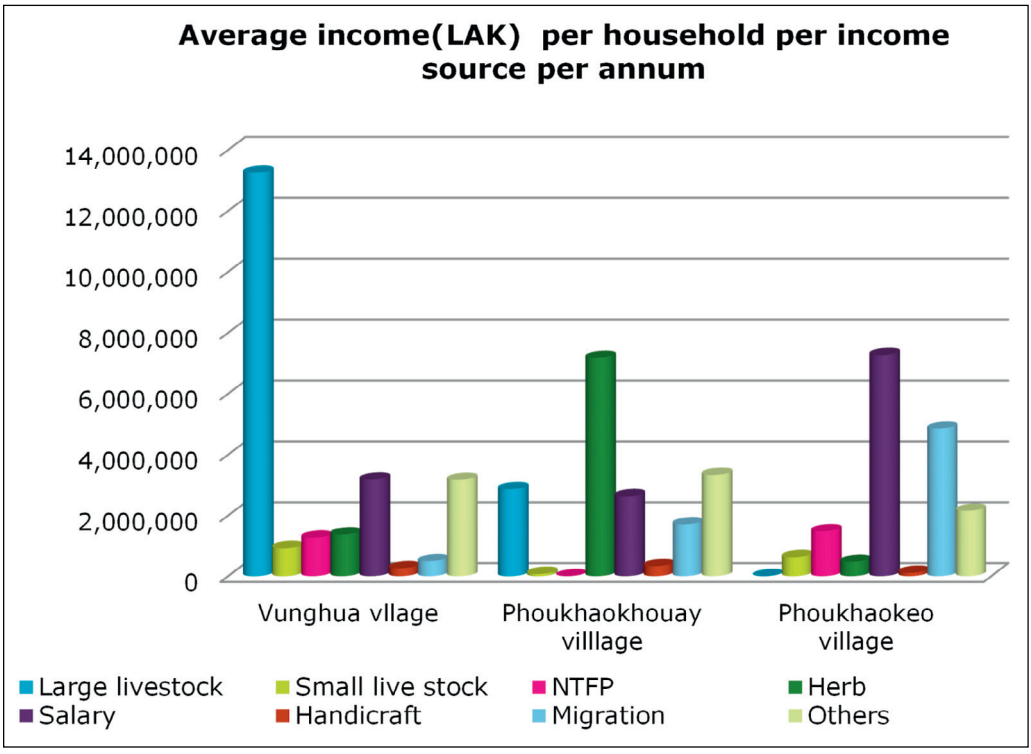

Fig. 2. Average incomes from each income source.
Note: One US Dollar = 7865 (LAK) Lao Kip in 2013. Source: Author's field survey 2013.

Table 4
Average annual income per household.

Village	Average annual income per household (2013) (₭)	Statistical range
Vunghua	23,982,245	Max: 96,000,000 Min:1,000,000 SD:20,097,935
Phoukhaokhouay	18,123,500	Max: 96,000,000 Min:800,000 SD:16,529,770
Phoukhaokeo	16,963,529	Max: 43,560,000 Min:2,300,000 SD:11,487,037

Note: 1 US Dollar = 7865 Lao Kip in 2013.Source: Author's field survey 2013.

Table 5
Frequency distribution of household incomes, as reported by residents of three villages in 2013.

Income range (million ₭) /year	Vunghua	Phoukhaokhouay	Phoukhaokeo	All villages
	(Proportion of households interviewed, in percent)			
1–10	32	43	24	33
10–20	24	25	35	28
20–30	16	20	29	21.5
30–40	8	6	6	5.6
40–50	8	3	6	6.6
50–60	8	0	0	2.6
60-above	4	3	0	2.3
Total	**100**	**100**	**100**	**100**

Source: Author's field survey 2013.

of their household income serving as migrant labor or in other non-farming activities. While this income is sufficient to sustain their livelihoods, many respondents worried about their children's future, especially because they lack agricultural land to inherit. Also, as they aged, they would not be able to sell their labor, or migrate from the village.

Several young men in the villages reported to have engaged in illegal logging trade, since dam construction, to meet their livelihood needs. Valuable timber in the park, however, is becoming increasingly scarce, due to heavy logging. Large animal sales for Vunghua village in particular and other non-farming income sources for all three villages are expected to remain the main income sources in the long-term.

6.2. Expenditure

To develop a clear picture of a villager's livelihood outcomes in monetary terms, we examine the expenditures on selected items. Here, we discuss the average annual expenditure per household, focusing on four expense categories: (1) food; (2) education; (3) electricity; and (4) land taxes in 2013 (Fig. 3).

Expenditure on food was higher in the two resettled villages than in the non-resettled village, as villagers in Phoukhaokhouay and Phoukhaokeo are far from forestland and some of them have no agricultural land. Thus they engage more in non-farming activities, and therefore must purchase more of their food. Eighty percent of Phoukhaokhouay respondents and 71% of Phoukhaokeo respondents report higher expenditures since resettlement. In particular, they spend more on food and education. Thirty-nine percent of Vunghua respondents report higher expenditures, primarily on education.

Because there is no high school in Vunghua, students must attend the district high school, located 25 km from the village. Thus, Vunghua villagers must pay for additional transportation, or for lodging,

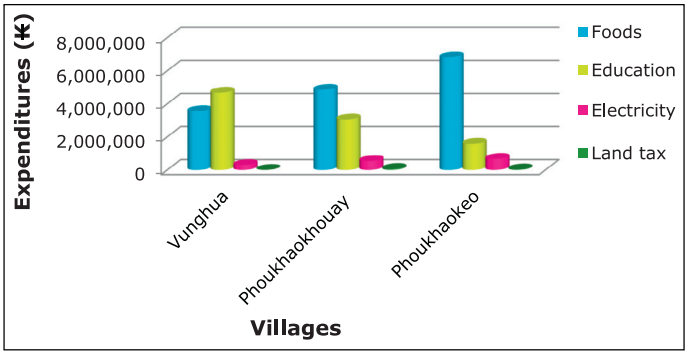

Fig. 3. Annual average expenditures per household per category.
Note: One US Dollar = 7865 (LAK) Lao Kip in 2013. Source: Author's field survey 2013.

if they send their children to stay in the school dormitory. Students from the resettlement villages can attend school in the morning and return home in the evening.

The other two expenditure categories are largely similar in the three villages. However, residents in the two resettled villages tend to consume more electricity per month, because it is hotter in the lowlands than on the plateau, thus requiring residents to use fans and refrigerators.

6.3. Food security

In general, rural people in Laos do not monitor the amount of food they collect from rivers or forests, and the amount of food collected varies over time. Moreover, measurements are always approximate. The time spent collecting food also varies. Here, we discuss food security data based on the perceptions of rice consumption sufficiency throughout the year. During interviews, respondents were asked to quantify their rice production yearly and also to note whether or not they had sufficient rice for household consumption throughout the year. The following figures show the proportions of interviewed households with: (1) sufficient annual rice consumption; (2) with insufficient annual rice consumption; and (3) with sufficient rice consumption only in some years. The results show in Fig. 4 below.

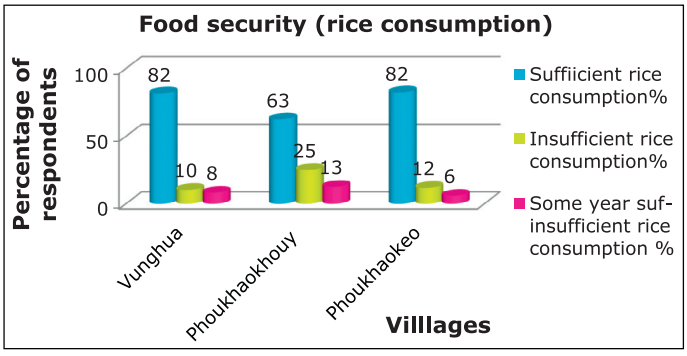

Fig. 4. The proportions of households reporting sufficient rice consumption in 2013. Source: Author's field survey 2013.

In Vunghua and Phoukhaokhouay villages, most of the respondents reporting insufficient rice consumption are shifting cultivators. Fig. 4 shows that in Vunghua village, 82% of respondents reported to have sufficient rice to consume throughout the year, while only 10% did not. In Phoukhaokhouay, 13% of those who occasionally experienced shortfalls were both shifting cultivators and rented agricultural land. Eighty-two per cent of Phoukhaokeo village respondents report they can usually obtain sufficient rice throughout the year, which they can purchase from markets using income from their off-farm activities. Those who reported insufficient rice supplies cited increased expenditures, because they had larger families now, or because they were dependent on support from their children. Agricultural land still plays an important role in maintaining food security, because households with their own paddy land tend to have more rice consumption through the year than those who rent land. Nonetheless, most of the households we interviewed earn some non-farming income to buy rice and other food supplies. Some respondents link (in)sufficient rice consumption primarily with households' expenditure and off-farm income, rather than access to paddy land. Shifting cultivators likely will experience more difficulties, given that it has become increasingly difficult to farm inside the national park.

7. Factors constraining livelihood adaptation and development

The Nam Mang 3 hydropower project has incorporated the different types of assets (e.g. human, physical, social, financial) in its program of substituting the affected communities' livelihood assets. Yet our case study reveals that some livelihood assets are more crucial than others in determining a rural household's ability to adapt its livelihood practices after dam construction. While the different types of livelihood assets and capitals are equally important for livelihood diversification strategies, some assets, such as access to farmland and natural resources (fisheries and forest land) are more important for rural household's adaptation strategies and their ability to improve livelihoods and ensure food security.

Insufficient agricultural land is the major factor constraining livelihood adaptation and development in the two resettled villages. Many villagers from Phoukhaokeo and Phoukhaokhouy have turned to renting agricultural land. These farmers have higher expenditures for renting land. Many villagers from Phoukhaokhouy, however, had accumulated substantial agricultural land (because their village is much older than Phoukhaokeo). Hence, they received larger amounts of compensation, and were able to buy land when they were relocated. Many did not, however, and as a result complained of insufficient agricultural land. Households from old Phoukhaokhouy village, who were resettled in Vunghua village, also complained of insufficient agricultural land, particularly for paddy cultivation.

Furthermore, under the resettlement scheme, grazing land was not provided. Hence, many families in Phoukhaokeo and Phoukhaokhouy were no longer able to raise livestock. The number of large livestock in both resettled villages has decreased since the dam's construction.

Restricted access to natural resources in the national park and the long distance to forest resources, in particular for the two resettled villages, have significantly reduced villagers' ability and assets to sustain and improve livelihoods. For example, none of the respondents from the two-resettlement villages has access to the forest, creating problems for the collection of firewood and forest-based food sources. Many villagers still collect food, firewood, and other forest products in the national park. A great challenge to Vunghua villagers has been the restrictions on shifting cultivation in the Phoukhaokhouy National Park.

Poor soil quality and land suitability reduce villagers' livelihood adaptation strategies. For example, in line with the resettlement action plan, 34 ha of land was allocated to rural households in Phoukhaokhouy. In practice, however, villagers have not made much use of the land, due to its sandy, dry condition, and lack of access to irrigation water. Responding to this constraint, some villagers collect firewood from the land, while others cultivate a small amount of cassava to feed their poultry.

Poor agricultural skills were also mentioned by villagers from both Phoukhaokeo and Phoukhaokhouy (especially those without suitable agricultural land) as one of the factors constraining livelihood adaptation and reconstruction. In Vunghua, many of the affected households could access agricultural land (both paddy land shifting cultivation) easily, yet 82% of respondents report having never received training in new cultivation methods, and thus rely largely on traditional cultivation methods.

Finally, the lack of funding was identified as the main constraint to investing in livelihood development. A microfinance system was introduced and developed in Phoukhaokeo, but the funding involved was very small. While the idea to develop microfinance system has been introduced in both Phoukhaokhouy and Vunghua, village authorities have not established the necessary institutional arrangements, leaving rural households without access to microfinance.

8. Conclusions

Hydropower development in the vicinity of the Nam Mang 3 hydropower project has impacted farming households and communities. The impacts vary with household access to livelihood assets and natural resources, before and after resettlement, and with household adaptation strategies. The subsequent livelihood outcomes also vary across villages, with differences in location, resettlement status, and strategic decisions regarding compensation programs.

Our analysis leads to three main findings related to resettlement and livelihood asset substitution. First, villagers adjust to the environmental and socio-economic impacts of the Nam Mang 3 hydropower project in different ways. In Phoukhaokeo village, remittances from family members who have migrated are a significant source of household income. Half of the female respondents in Phoukhaokhouy village sell traditional medicines. Moreover, losing access to land (paddy land, forest area, and grazing land) has led some villagers to engage in illegal trade of timber and non-timber forest products. In Vunghua village, 48% of respondents report such engagement. Rural households view these activities merely as 'survival' strategies, rather than the best ways to improve livelihood outcomes. Alternative policies are needed to ensure that impacted communities can achieve their livelihood goals in a sustainable manner.

Second, access to agricultural land (mainly paddy fields) continues to play an important role in the ability of households to sustain livelihoods, improve income, and rise above the poverty threshold (McDonald-Wilmsen and Webber, 2010; Webber, 2010). For this reason, many farmers in Vunghua village have been more successful in sustaining their livelihoods and improving income than farmers in the other two villages. They are better off in terms of rice consumption and also household income, as they still have access to grazing land and also to reservoir fisheries. Farmers in Phoukhaokhouy and Phoukhaokeo have limited access to agricultural land, and they must rent land or engage in shifting cultivation. They also engage in wage labor jobs, often via migration, to replace the household income no longer available through agricultural production.

Finally, some rural households in the resettled villages are unable to rise out of poverty because they lack the ability to invest in livelihood activities. Villagers must spend most of the money they earn from off-farm activities on food and other household consumption items. Villagers face substantial challenges in substituting for lost livelihood assets, and generating sufficient income, as alternative employment is lacking. Obviously, livelihood asset substitution can contribute to improving livelihood outcomes only when villagers are provided with alternative assets (e.g., technical training, access to credit) that could support them in reconstructing their 'lost' livelihoods. Policies and programs addressing the inadequate access to alternative livelihood assets would be helpful in providing households with viable opportunities to increase their annual income, improve their food security, and eventually rise above the poverty threshold.

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